Surface-Altered Zeolites as a Permeable Barrier

Developer: New Mexico Institute of Mining & Technology
Contract Number: DE-AR21-95MC32108
Crosscutting Area: ESP

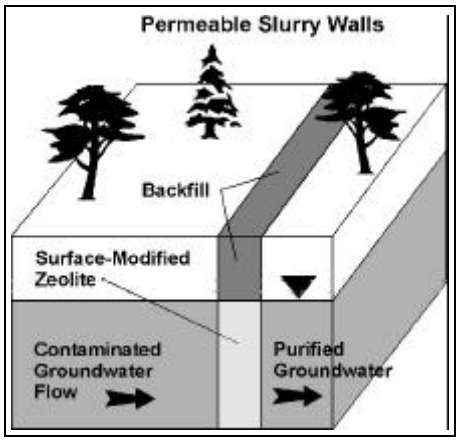
Subsurface Contaminants FOCUS AREA

Problem:

Contamination of shallow groundwater by organic and inorganic pollutants is common at many Department of Energy (DOE) and industrial facilities. Often it isn't the level of contamination, but the volume of groundwater contaminated, which dictates the ultimate cost of groundwater cleanup. Any technology which can retard the migration of pollutants while remediation solutions are designed and implemented will be valuable. Impermeable slurry walls (composed, for example, of bentonite mixtures) attempt to prevent the bulk movement of contaminated groundwater. Due to the resulting hydraulic gradients, such underground dams often fail due to groundwater movement over, under, or around the barrier.

Solution:

Development, pilot-scale demonstration, and field installation of a permeable barrier of altered zeolite which is selective for the major classes of groundwater contaminants: soluble organics such as benzene and trichloroethylene, inorganic cations such as lead and cadmium, and inorganic anions such as chromate and arsenate. Such a barrier would retain contaminants while allowing the groundwater to pass through.



Benefits:

‣Permeable barriers provide economical means to limit groundwater contaminant migration

‣Surface-altered zeolites display a selectivity for the major classes of groundwater contaminants

‣Zeolites are widely available and low cost (approximately $100/ton ground and sized at the mine)

‣The surface modification is straightforward and results in a material which is cost-competitive ($300-$500 per ton)

‣Existing slurry-wall technology can be used for installation of permeable zeolite barriers

‣Other treatment technologies (e.g. bioremediation, air stripping) can be focused within the barrier rather than on the entire contaminated aquifer

Technology:

Zeolites are naturally occurring minerals which are widely distributed in near-surface deposits in the western U.S. and other parts of the world. Raw zeolite has a high adsorptive capacity for positively charged contaminants such as lead and ammonium--in fact, cat litter is currently the largest market for raw zeolite. By treating the zeolite with cationic surfactants like those found in hair conditioner and mouth wash, the zeolite gains the ability to adsorb organics and negatively-charged inorganic contaminants, while retaining most of its ability to adsorb positively-charged inorganics. The surface-altered zeolite thus can adsorb all the major classes of groundwater contaminants. Although fundamental zeolite

particles are in the sub-micron range, they occur in massive deposits of stable aggregates which can be ground and sized to any distribution. Thus the hydraulic properties of the zeolite can be tailored as desired. This makes surface-altered zeolites ideal for applications such as permeable barriers, packed-bed reactors, and other flow-through systems.

The project is designed to test the viability of surface-altered zeolites as permeable barriers to prevent groundwater-contaminant migration. It will test the adsorptive properties and stability of the altered zeolite in the laboratory, install a pilot-scale permeable barrier to test emplacement methods and predictability of contaminant migration, and evaluate the effectiveness of the altered zeolite at an actual contaminated site.

Contacts:

The New Mexico Institute of Mining and Technology is an institution of higher learning which supports graduate education and research in the area of environmental remediation. For information on this project, the contractor contact is:

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